Multi-Locational Trials Using Bio-Plant and Pro-Plant on Rice and Maize

Bio-fertilizers for Soil Treatment in Sierra Leone





REPORT PRESENTED

BY

THE DIRECTORATE OF AGRICULTURAL EXTENSION,
MINISTRY OF AGRICULTURE FORESTRY AND FOOD SECURITY

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COMPANY BACKGROUND AND INTRODUCTION

Artemis & Angel Co. Ltd. is Thailand's leading company for producing advanced bio-technology, liquid bio-fertilizers. Artemis & Angel Co. Ltd. was founded in 1984 by the company President, Somkiet Panjanapongchai. From 1984 until mid-2009 it was called Artemis & Angelio Co. Ltd.

The main office is in central Bangkok while the production facilities are outside the city area. The company is registered with the Thai Ministry of Commerce. The company has agents in Africa, Asia, and South America.

Artemis represents the goddess of Nature in Greek mythology. She was concerned with matters of the outdoors, animals, and environmental protection. She was practical, adventurous, athletic and preferred solitude. She symbolizes regenerative earth power over all living things. **Angel** is a benevolent, divine messenger who brings help and blessings.

The company manufactures:

Bio-Plant and Pro-Plant: These are advanced bio-technology, 100% organic, liquid, microbial bio-fertilizers, which enable a country to phase out chemical agriculture and replace it with 100% organic farming.

They lower the cost of food production; increase the yield above what chemical fertilizers can achieve; restore the soil's fertility by infusing it with a huge concentration of micro-organisms; reduce disease significantly; and produce healthy, chemical-free food.

In bio-chemical farming the bio-fertilizers enable farmers to halve the amount of chemical fertilizers they use in the first season while still increasing the crop yield. The rest of the chemicals can be phased out over the following 2 years. This is a pace of change that even hardened chemical farmers can accept.

Granular & Powder Bio-organic NPK3 and NPK4 Called Red Sun

They can be used to replace Urea and NPK. While the bio-technology of the liquid bio-fertilizers is by far superior to the old-style technology of granular fertilizer, this product is for chemical farmers who do not want to give up granular fertilizer.

Bio-Utility

For the treatment of municipal waste water and rubbish which can then be used to make agricultural soil. Bio-Plant can also be used for these purposes.

Belta Pro-biotic

The Belta Probiotic is a very high quality probiotic product that improves the digestion of livestock and poultry, such as cows, buffalos, chickens, sheep, and pigs, so that they absorb more protein, minerals, etc. Their weight increases noticeably more quickly than in animals not taking Belta Probiotic. They become healthier and their immune system is strengthened so that they are much less liable to fall ill.

Bio-Plant and Pro-Plant are the result of research in bio-technology which the company President, Somkiet Panjanapongchai has carried out over many years. He has discovered new processes that make

it possible to put the micro-organisms and fungi groups, and major and minor minerals of fertile soil into a very concentrated liquid form, and to create a pair of synergistic, microbial, 100% organic bio-fertilizers that can restore the fertility of soil within 2-3 years; even soil beaten to death by 20-30 years of chemical fertilizers and sprays.

The Credit Fund

The company also provides a 0% interest, 12-month Credit Fund of at least US$25 million per year (for up to 5 years per contract, with no price increase) in the form of the bio-fertilizers to enable a government to provide farmers throughout the country with the bio-fertilizers on credit so that the country can make the transition from 100% chemical farming to bio-chemical farming, and then to 100% organic farming over 3 years. We suggest 3 years purely because this is a pace of change that chemical farmers can accept

It is common that farmers are afraid to change over to using 100% organic fertilizers. 90% - 95%+ of farmers in any country are chemical farmers, and their family has been chemical farming for 20-30 years. That's all they know. Very few will change over directly as they are afraid of change, afraid of the unknown, afraid of reduced yield, afraid of losing income, etc.

Basically, one needs to understand their fears and to remove them. But if they are told the benefits of bio-chemical farming, then they will move from chemical farming to bio-chemical farming for the following main reasons.

1. Chemical farmers are hurting emotionally, physically, and financially from the effects of chemical agriculture. This is a global problem, and not limited to Nigeria.
2. The soil has become terribly weak and hard as chemical fertilizers and sprays have killed off the micro-organisms of their once fertile soil. These micro-organisms create a strong immune system that protects the crops from disease, but as they have been killed off by soil acidity and chemicals, the immune system of the crops has been weakened, and crop disease is rife. I have seen so many unhappy farmers because of this.
3. The soil has become terribly weak and hard as a result of excessive use of chemical fertilizers and the resulting lack of micro-organisms, and the farmers‟ crop yields are lower. To deal with this the fertilizer agents tell them to buy more chemical fertilizer and more sprays, which just makes things worse. The farmers cannot get out of the vicious cycle that they are caught up in unless they phase out chemical fertilizers and sprays. Bio-chemical farming helps them here.
4. Add to this the rising costs of chemical fertilizers and sprays, which reduce their profits more each year. Chemical farmers are usually trying to reduce their costs because chemical fertilizer prices keep rising. They have to increase the amount of chemical fertilizer they use each year just to get the level of previous yields as their soil weakens.

Bio-chemical farming with Bio-Plant and Pro-Plant offer them a solution that farmers can adopt. In bio-chemical farming, by mixing 330 cc of Bio-Plant with a 50 kgs bag of chemical fertilizer, a farmer can use half as much chemical fertilizer over the same area. He can apply it just like chemical fertilizer. He will have a small 10% increase in the yield, but he can increase this to about 30% in the first year by: (a) mixing Bio-Plant with the seeds and the soil during the soil preparation, and (b) by spraying Pro-Plant on the leaves. Farmers usually like this.

This report presents results of a multi-locational trials conducted by the Extension Division of the Ministry of Agriculture Forestry and Food Security from April to September 2015 to test the efficacy of the Bio-Plant and Pro-Plant Bio-fertilizer product on the yield and productivity of rice and maize in Sierra Leone. The trials were conducted in collaboration with the ministry's district offices using the FBO approach in four locations including Lambayama in Kenema District, Mandu in Bo District, Makali in Tonkolili District and Tombo in Western Rural District.

RESEARCH RESULTS BY LOCATION

Multi-locational trails were conducted using the Artemis & Angel Co. Ltd. field guidelines for using Bio-Plant and Pro-Plant products in growing rice and maize as follows:

Lambayam, in Kenema Site

The first /main cropping season was used for both maize and NERICA L19. The maize crop did well in terms of physiological growth when compared to the Control. The rice on the other side did not show any marked difference in physical growth and yield. This was certainly due to heavy rains and flooding that occurred just after the application of the Pro-Plant fertilizer. The rice was cultivated in swamp, which compounded the problem. No yield data was obtained from the maize plots because the FBO members where excited about the high yield recorded.

Mandu Site, in Bo District

In Kenema, both maize and rice were planted at Mandu village. Both the maize and rice showed significant increase in yield as compare to the Control. The number cobs of maize was high in plots with Bio-fertilizer than Control plots.

Makali, in Tonkolili District

In Tonkolili, no maize was planted because no FBO had maize when the programme was implemented. The field results showed that the rice did extremely well when Bio-fertilizer was applied than in the Control. In the applied plot of 25 square meter area with yield of 1.3 kg dry weight equivalent to 5.2 metric tons/ha) as against Control area yield of 0.08 kg equivalent to 3.2 metric tons/ha under the same cultural operations of crop management.

Tombo in the Western Rural District

Because of the proximity of Tombo and Freetown HQ a higher concentration in field supervision was done. Both dry (off) season and rainy (main) season double cropping was done for both rice and maize alternatively using the same FBOs in close proximity. In the dry season, the first Site was established in early April 2015 while the other Sites during rains. The physical growth and yield were very distinct similarly so in the second cropping season. The western Area farmers after seeing the good performance of the bio-fertilizer on their crops were very eager to get the products if only it was out for sales to the public but were informed that the products were only available for field test.

The performance of the Bio-fertilizer products was rated as very good by the participating farmers as compared to non-application of the product. The farmers who participated in this research and eager to have these products because they believe they will increase productivity

When 330 cc of Bio-Plant is mixed with a 50 kgs bag of chemical fertilizer and used for bio-chemical farming the farmers can reduce straight away by 50% the amount of chemical fertilizer and pesticides that they use. The increase in the yield is usually 30% when Bio-Plant is used in the seed and soil preparation, and Pro-Plant is sprayed on the leaves. In Year 2 and Year 3 farmers can reduce their chemical fertilizer by 25% each year until after 3 years they are not using chemicals anymore and have a higher yield for much lower costs.

For the best results in bio-chemical farming, also prepare the seeds with Bio-Plant; prepare the soil with Bio-Plant mixed with plenty of organic matter (1 litre of Bio-Plant mixed with 5 tons of organic matter per hectare); and spray Pro-Plant onto the leaves, flowers, and the resulting seeds. There are different ways to increase the rate of multiplication of the micro-organisms in Bio-Plant.

Bio-chemical farming in this way enables farmers to make the changeover gradually. It also puts the decision in their hands, and when they see the benefits, they make the decision to stop chemical farming and to become organic farmers. They do not need to be told to do it. Some stay with bio-chemical farming, of course, but that is fine.

Chemical farmers will move away from chemicals, but you have to help them to do it in a way they can accept, which is a phased way. Bio-chemical farming provides the phased way and enables them to carry on using granular fertilizer, though gradually less and less, and they feel safe with this approach.

The action of the micro-organisms turns the granular fertilizer into a factory mass-producing the very micro-organisms, which the soil is lacking. This is why they can halve the amount of Urea / NPK / DAP / etc., that they use. The farmers see that by using half the amount of chemical fertilizer they can still get at least the same yield, and there is actually usually a small increase. Their costs will go down by about 40%-45% as well.

If they are happy with just saving costs, then they can carry on in this way. If they want to increase their yield by about 30%, and phase out another 25% of their chemical fertilizers in Year 2, then they need to get used to some of the habits of organic farming, namely soil preparation (with Bio-Plant) and spraying leaves with a foliar spray (Pro-Plant). We find that farmers will do this as they see that they can reduce their costs more and increase their yield. In Year 3 they can stop using the final 25% of their chemical fertilizers. Bio-chemical farming empowers the farmers and puts them in the driving seat of change. They seem to like this.

After 3 years the farmers will be farming 100% organically and just using the liquid bio-fertilizers with a higher yield than they got with chemical fertilizers and at a lower cost. A phased change is much better as the farmers have to get used to 100% organic farming, and to changing their habits gradually. Also, this approach gives the soil time to recover through the infusion of micro-organisms, which the chemicals have usually killed off, in preparation for 100% organic farming.

They can also save more money by stopping to use chemical sprays in Year 1 as they are no through the effect of the micro-organisms in Bio-Plant while Pro-Plant protects the leaves from disease.

The bio-technology of the liquid bio-fertilizers in their liquid form is superior to the old style technology of the granular form. They feed the plants and restore the fertility of the soil. When you spray Pro-Plant on the leaves, the minerals go into the leaf straight away and the leaves are coated with disease-protecting micro-organisms. When minerals go through the soil and the roots, they take much longer to get to the leaves. This is why the effect of Pro-Plant on vegetables and leafy crops can be seen so quickly.

PRESENTATION OF FIELD REPORTS

Kenema District Field Report

Experiment Plot for Bio-fertilizer for Maize (Mares)

NO	CULTURAL PRACTICE	BIO-FERTILIZER EXPERIMENTAL PLOT	CONTROL PLOT	AREA CULTIVATED	PICTORAL EVIDENCE BIO PLOT	PICTORAL EVIDENCE CONTROL	RESULT
1	Site Selection	Determined based on the nature of the soil	Determined based on the nature of the soil	One acre (0.5 for Control and 0.5 for experimental plot	6th April, 2015	6th April, 2015	Site selected
	Brushing	Manual Brushing using Cutlass (2 Man days)	Manual Brushing using Cutlass (2 Man days)		7th April, 2015	7th April, 2015	Land preparation ongoing
	Clearing	Done using Rakes, local hoe, Mattock	Done using Rakes, hoe, Mattock		8th April, 2015	8th April, 2015	
	Digging and Harrowing	Done using Khodali Hoe and cutlass	Done using Khodali Hoe and cutlass		9th April, 2015	9th April, 2015	Land prepared
	Lay outing	Measuring Tapes, pegs and cutlass to determine plant spacing (50 by 75 cm)	Measuring Tapes, pegs and cutlass to determine plant spacing (50 by 75 cm)				Land cleared and demarcated

	Top Dressing	First application of the Bio-fertilizer done through watering can with a mixture of 1ml of Bio-fertilizer to 10 litres of water	compost manure applied by pocketing method		9th April, 2015  Bio-fertilizer for maize	9th April, 2015	First application of Bio-fertilizer accomplished
	Planting	Row planting with a planting distance of 50cm between rows and 75cm within plants	Row planting with a planting distance of 50cm between rows and 75cm within plants		Date of planting 11th April, 2015	Date of planting 11th April, 2015	Planting completed
	1st Weeding	Done physically	Done physically		 21st April, 2015	 21st April, 2015	No difference detected at this stage
	2nd Bio-fertilizer Application	Second application of the Bio-fertilizer done through watering can with a solution of 1ml of Bio-fertilizer 10 litres of water	Earthen of the soil using small hoe				Growth rate at the same pace before the second application
	2nd Weeding	Physically done	Physically done				

	3rd Bio-fertilizer Application	watering can with a mixture of 1ml of Bio-fertilizer to 10 litres of water	Earthen of crop				The Control show pale yellow color leaves which is likely due to a deficiency of nitrogen
	Production of cob and flowering stage						Broad and thick green leaves shown at experimental plots while the Control shows narrow and pale yellow leaves

Experiment Plot for Bio-fertilizer for Rice

NO	CULTURAL PRACTICE	BIO-FERTILIZER EXPERIMENTAL PLOT	CONTROL PLOT	AREA CULTIVATED	PICTORAL EVIDENCE BIO PLOT	PICTORAL EVIDENCE CONTROL	RESULT
1	Nursery preparation	Wet nursery was done with 5kg of seed rice	Wet nursery was done with 5kg of seed rice	5m by 10m	5m by 10m nursery bed 	Same nursery as experimental plot 	Nursery established
2	Site selection	Ideal IVS Site for cultivation (rehabilitated) 50 x 80m plot	Ideal IVS Site for cultivation (rehabilitated) 20 x 40m plot	plot sizes Control plot 20 by 40m experimental plot 50m by 80m			Site selected
3	Brushing	Cutlass was used for brushing	Cutlass was used for brushing				Brushing completed
4	Clearing	Rakes and cutlass were used for clearing	Rakes and cutlass were used for clearing				Clearing done
5	Digging and pudding	Mechanically done using tractor	Mechanically done using tractor				Site prepared

6	Lay outing	System of rice intensification was method was done	System of rice intensification was method was done		 After transplanting	 After transplanting	Distance of 40 by 40cm between and within row was used
7	Top Dressing	Bio-fertilizer application	No fertilizer applied				Bio-fertilizer
8	1st weeding	Weeding done by three people	Weeding done by three people				Weeding completed
9	2nd Bio-fertilizer application	Bio-fertilizer application	No fertilizer applied				No impact due to flooding after application of Bio fertilizer

10	2nd weeding	Second weeding almost impossible due to flooding	Second weeding almost impossible due to flooding		 Flooded plot	 Flooded plot	Both plots difficult to do second weeding
11	Flowering stage				 After flooding	 After flooding	There is not much difference in the yield due to Heavy rains leading to shift of the Bio-fertilizer from the experimental location
12	Harvesting						Harvesting is ongoing at the two different plots simultaneously

Tonkolili District Field Report

DISTRICT: Tonkolili
NAME OF EXPERIMENTAL SITE: Barrayin
NAME OF FBO: Magbenyani
PLOT AREA: 20 m x 10 m
CROP & VARIETY: Rice (Nerica L19)
EXPERIMENTAL PERIOD: Mar – July 2015
DURATION: 5 months

CROP	Controlled plot (No fertilizer applied)		Bio-fertilizer applied	
	First photo (one month)	Observations seen (brief)	First photo (one month)	Observations seen (brief)
1.RICE (NERICA L19)		• There was iron toxicity which brought about a reduction in the growth rate and pattern. • Rat infestation was envisaged during this period • Vigour was encouraging in the early part of the vegetative stage, but leaf colour started to become sparingly yellow in the later stage • Tillering was normal as in the characteristics of the variety • Weed infestation was observed three weeks after		• Rapid Growth rate was observed after the application of the Boi-Fertilizer but was also hampered by the iron toxicity as some extent of stuntedness was noticed later • Case worm infestation was observed due to flooding of the plot but after the application of the bio-fertilizer, when the water recedes, the case worm infestation recedes, thus promoting growth. • After the first application, thirty days after

		transplanting. • After weeding was done there was not much difference in the growth rate of the rice between the Controlled and uncontrolled sites which could be attributed to the long fallowing period of the experimental Site		transplanting, weeds started to get brown, but because the application duration period was altered (which was supposed to be 10days from one application to the other), weeds started to emerge again which hampered the growth rate a bit.
	Second photo (flowering)	Observation seen (brief)	Second photo (flowering)	Observation seen (brief)
		• Most of the panicle sizes are not as large as the uncontrolled • Much stuntedness observed in the growth rate. • Disparity in the flowering stage was noticed • The size of the stalk was relatively smaller as compared to that of the uncontrolled plot		• Panicle size of most of the rice plant are much larger • Marked improvement in the3 growth rate. (Almost normal size attained) • Almost uniform flowering was observed Stalk size is larger as compared to the Controlled plot

	Final photo (Before harvesting)	Observation seen (brief)	Final photo (Before harvesting)	Observation seen (brief)
		• Smaller Grains • Slim panicles		• Bigger grains • Tough panicles
Socio-economic analysis	Area harvested L = X B = (Total area = 25 meters sq. = 0.025 ha) 1. Total harvested (wet) = 1.1 kg 2. Total harvested (dry) = 0.08 kg Total cost of harvest = Nil		Area harvested L = X B = (Total area = 25 meters sq. = 0.025 ha) 1. Total harvested (wet) = 1.9 kg 2. Total harvested (dry) = 1.3 kg Total cost of harvest = Nil	
Conclusion				

Bo District Field Report

DISTRICT: Bo
NAME OF EXPERIMENTAL SITE: Mandu
NAME OF FBO: Magbenyani
PLOT AREA: 20 m x 10 m
CROP & VARIETY: Maize (Mares)
EXPERIMENTAL PERIOD: 26/4/15 to 19/7/ 15
DURATION: 3 months

Controlled plot (No fertilizer applied)		**Bio-fertilizer applied**	
First photo (one month)	Observations seen (brief)	First photo (one month)	Observations seen (brief)
	1. Germination over 80%. 2. Uniform growth. 3. Slopey land		1. Germination over 80%. 2. Uniform growth. 3. Slopey land 4. Growth excellent

Second photo (flowering)	Observation seen (brief)	Second photo (flowering)	Observation seen (brief)
	Heavy rain during this growth period No. of stand per plot not maintained (missing stands) with no significant difference in height against the Control		Heavy rain during this growth period has the tendency for washing off Bio-fertilizer after spraying No. of stands per plot maintained with no significant difference in height against the Control
Final photo (Before harvesting)	Observation seen (brief)	Final photo (Before harvesting)	Observation seen (brief)
	Not all stands produced edible cobs and comparatively smaller than the bio-fertilizer plant cobs		Almost all stands produced edible cobs and comparatively better than the Control plant cobs

Area harvested L=10 X B = 20 (Total area= 200 meter sq =.02ha) 1. Total harvested (wet) = 376 cobs = 24kg 2. Total harvested (dry) = Nil Total cost of harvest =	Area harvested L=10XB=20 (Total area= 200 meter sq =.02ha) 1. Total harvested (wet) = 416 cobs=26 kg 2. Total harvested (dry) = Nil Total cost of harvest =
Strongly recommend that trial be repeated during the dry season to escape effects of heavy rains, which it is assumed had negative effect on the Performance of Bio-fertilizer	

Note: Attached is the result a third trial plot using inorganic fertilizer (NPK 15:15:15) conducted alongside the Bio-fertilizer trials for further analysis and may be designs in future.

RECOMMENDATIONS

Data to be collected or reporting format to be available before on set of field implementation of trials for proper data collections.

Bo District Field Report

DISTRICT: Bo
NAME OF EXPERIMENTAL SITE: Mandu
NAME OF FBO: Magbenyani
PLOT AREA: 20 m x 20 m
CROP & VARIETY: Rice
EXPERIMENTAL PERIOD: June – August 2015
DURATION: 3 months

Controlled plot (No fertilizer applied)		**Bio-fertilizer applied**	
First photo (one month)	Observations seen (brief)	First photo (one month)	Observations seen (brief)
	Plants too young and small significant observations. Soil observed to be very fertile		

Second photo (flowering)	Observation seen (brief)	Second photo (flowering)	Observation seen (brief)
			
Final photo (Before harvesting)	Observation seen (brief)	Final photo (Before harvesting)	Observation seen (brief)
Area harvested L = X B = (Total area = meter. sq = ha) 1. Total harvested (wet) = 2. Total harvested (dry) = Total cost of harvest =		Area harvested L = X B = (Total area = meter. sq = ha) 1. Total harvested (wet) = 2. Total harvested (dry) = Total cost of harvest =	
Conclusion will be made after harvest			

Western Area Field Report

The first pictorial field report of bio-fertilizer trials in western area at Tombo on Nerica and maize Site during the off-season/dry season cultivation season 2015.

Bio-fertilizer Application (MAIZE)	Controlled Plots (no fertilizer) - MAIZE
 Newly applied Pro-Plant fertilizer on the two weeks old maize with some green vegetable leaves intercropped with maize Note: This was the position we found the maize farmer in terms of cultivating maize intercropped with grain-grain leaves for quick money in selling the vegetable leaves before harvesting the maize.	 The Controlled plot where no Pro-Plant fertilizer was applied

Bio-fertilizer Application (MAIZE)	Controlled Plots (no fertilizer) - MAIZE
 Female maize farmer at Tombo, Western Area Bio-Fertilizer	 The same Female maize farmer at Tombo, Western Area without Bio-fertilizer – as the Controlled plot.
 The status of grain-grain leaves also benefitted the Bio-fertilizers during the maize Bio-fertilizer application.	 The few grain-grain leaves in the Controlled plot was not doing well as you can see from the photo.

	Because of the Bio-fertilizer application the maize growth was very high so much that there was over crowding of maize plant beyond the expectation of the farmer including the grain-grain leaves intercropped. The grain–grain leaves have been harvested now twice.

Bio-fertilizer Application (NERICA)	Controlled Plots (No Fertilizer) - NERICA
	
This was the situation we found the farmer with his NERICA farm	This was the situation we found the farmer with his NERICA farm planted
	
This was the situation after the Bio-fertilizer application with the foliar application of only Pro-Plant with an interval of 10 days	This was the Controlled plot in a very stunted and weak condition In the same vicinity at Tombo, Western Area.

	
This was the second plots with Pro-Plant fertilizer application with liquid /foliar application	This was the second plots under the Controlled situation without liquid / foliar application of Pro-Plant

Annex 1: Field Test Guidelines for Using Bio-Plant and Pro-Plant to Grow Rice and Maize on an Area of Land Size 1,800 Square Meters

1. Bio-fertilizer Requirement

1. Suggested Area Per Crop

- You have 5 litres of the bio-fertilizers. Divide the total area of 1,800 sq.m. into two areas. One area will be for bio-chemical farming and the other area for 100% organic farming. *(See the table on page 2 and the diagram on page 3.)*
- In the 100% organic farming area there will be 2 strips of 15 m x 15 m. – one for rice and one for maize.
- In the bio-chemical area there will be 3 strips of 30 m x 15 m each. Two for maize and 1 for rice.

2. Amount of Bio-Plant and Pro-Plant Needed

Soil Preparation of the Whole Area

- Total Bio-Plant needed: 500 cc of Bio-Plant + 200 cc of Pro-Plant.
- Use 500 cc of Bio-Plant mixed with 200-500 litres of water for the soil preparation over the whole test area (100% organic farming and bio-chemical areas together). Normally a farmer would mix 500 cc with 500 litres of water and 5 MT of organic matter per hectare, but this amount of water may be too much water for the 1,800 sq.m. area. 200 litres of water or more will be fine. Mix it with 4 MT of organic matter as described below on page 2.

2 Tests: 100% Organic Farming with Pro-Plant (land area 15 m x 15 m per crop)

A. Rice: 6 x 50 cc of Pro-Plant in 50 litres of water per time = 300 cc
B. Maize: 6 x 50 cc of Pro-Plant in 50 litres of water per time = 300 cc

- Total Pro-Plant: 600 cc.

2 Tests: Bio-chemical Farming using Bio-Plant & Pro-Plant (land area 30 m x 15 m per crop)

C. Rice: 6 times x 100 cc of Pro-Plant in 100 litres of water per time = 600 cc
D. Maize: 6 times x 100 cc of Pro-Plant in 100 litres of water per time = 600 cc

- Total Pro-Plant: 1,200 cc.
- Total Bio-Plant: 330 cc per 50 kgs bag of Urea and NPK used. Maximum 1 litre.

1 Test: Bio-chemical Farming with Bio-Plant Only (land area 30 m x 15 m per crop)

E. Maize. If you wish, you could choose rice instead.

- Area: 30 m x 15 m. You have enough Bio-Plant to double the area of this bio-chemical test. Just make sure that the number of bags of chemical fertilizer used in all of the bio-chemical farming tests is not more than 6 bags.
- Total Bio-Plant: 330 cc per 50 kgs bag of chemical fertilizer used. Maximum about 2 litres (if 6 bags of chemical fertilizer are used).

Overall Total of Bio-Plant and Pro-Plant Used in All of the Tests Above

- Total Pro-Plant: 2.60 litres (roughly)
- Total Bio-Plant: 2.80 litres (roughly)

2. Summary of the Field Tests by Area

100% Organic Farming Test Areas	Bio-chemical Farming Test Areas
Test A: Rice • **Area:** 15 m x 15 m • **Bio-Plant:** The soil should be prepared with Bio-Plant and organic matter. Leave the land for 2 weeks before planting rice. • **Seeds:** Soak them in Bio-Plant and Pro-Plant. • **Pro-Plant:** Spray 6 times x 50 cc in 50 litres of water per time (300 cc) on Days 30, 40, 50, 60, 70, 80.	**Test C: Rice** • **Area:** 30 m x 15 m • **Bio-Plant:** The soil should be prepared with Bio-Plant and organic matter. Leave the land for 2 weeks before planting rice. • **Seeds:** Soak them in Bio-Plant and Pro-Plant. • **Bio-chemical Mixture:** Mix Bio-Plant with Urea and NPK and apply them in the usual way chemical farmers apply them. • **Pro-Plant:** Spray 6 times x 100 cc in 100 litres of water per time (600 cc) on Days 30, 40, 50, 60, 70, 80.
Test B: Maize • **Area:** 15 m x 15 m • **Bio-Plant:** The soil should be prepared with Bio-Plant and organic matter. Leave the land for 2 weeks before planting rice. • **Seeds:** Soak them in Bio-Plant and Pro-Plant. • **Pro-Plant:** Spray 6 times x 50 cc in 50 litres of water per time (300 cc) on Days 30, 40, 50, 60, 70, 80.	**Test D: Maize** • **Area:** 30 m x 15 m • **Bio-Plant:** The soil should be prepared with Bio-Plant and organic matter. Leave the land for 2 weeks before planting rice. • **Seeds:** Soak them in Bio-Plant and Pro-Plant. • **Bio-chemical Mixture:** Mix Bio-Plant with Urea and NPK and apply them in the usual way chemical farmers apply them. • **Pro-Plant:** Spray 6 times x 100 cc in 100 litres of water per time (600 cc) on Days 30, 40, 50, 60, 70, 80.
	Test E: Maize • **Area:** 30 m x 15 m. • **Bio-Plant:** The soil should be prepared with Bio-Plant and organic matter. Leave the land for 2 weeks before planting rice. • **Seeds:** Soak them in Bio-Plant and Pro-Plant. • **Bio-chemical Mixture:** Mix Bio-Plant with Urea and NPK and apply them in the usual way chemical farmers apply them.

3. Soil Preparation of the 1,800 sq.m. Test Area

100% Organic Farming	Bio-Chemical Farming
Test Area A 15 m x 15 m	**Test Area C (Rice)** 30 m x 15 m
Test Area B 15 m x 15 m	**Test Area D (Maize)** 30 m x 15 m
	Test Area E (Maize) 30 m x 15 m

Instructions

1. Prepare the soil of the whole 1,800 sq.m. area at one time.
2. Do not prepare the soil of the chemical Control area as chemical farmers do not prepare their soil with organic matter.
3. Prepare the organic matter (dead leaves, cow dung, chicken dung, crop stubble, sugarcane factory waste, etc.). Use 4 metric tonnes of organic matter.

Notes

1. We suggest that you use 500 cc of Bio-Plant in the soil preparation of the whole area of 1,800 square metres. Mix this with 200-500 litres of water, and then mix it into about 4 MT of organic matter. Spread this over the test area and plough it into the ground. A lot of organic matter is important in the tests. At least 4 MT is desirable. Then leave the land for 14 days before planting to allow the micro-organisms time to multiply.
2. Normally, a farmer would mix 500 cc with 500 litres of water and 5 MT of organic matter over one hectare. But as 500 litres of water may be too much water for the 1,800 sq.m. area, 200 litres of water (or more) will be fine.
3. 500 cc of Bio-Plant is more than normal for 1,800 sq.m., but we would like to show the effect Bio-Plant can have on the soil.
4. The more organic matter that the micro-organisms of Bio-Plant have to feed on and multiply in, the better. If the soil is very weak and sandy, use as much organic matter as you can. The waste from sugarcane factories is very useful as organic matter. Usually the factories throw this away.
5. If 30% or more of the organic matter can be chicken dung, this would be good. Cow dung can be used to supplement the chicken dung.
6. Mix the organic matter with 500 cc of Bio-Plant. Shake the bottle well before using it. Pour water into the bottle to wash all the Bio-Plant out. Mix this with 500 litres of water. This will be mixed into the organic matter. Spread this organic matter mixed with Bio-Plant over the area of land and plough it in.
7. The Bio-Plant helps to break down the hard soil (made hard by the use of chemical fertilizers) in order to start the process of micro-organisms growing in the soil again (killed by over-use of chemical fertilizers and pesticides), and to remove the chemicals from the soil (left by the chemical fertilizer and pesticides).
8. Do not use herbicides with any weeds as herbicides and pesticides kill the micro-organisms in the bio-fertilizers. Bio-Plant can be used as an organic herbicide anyway. (Mix 100 cc of Bio-Plant with 20 litres of water and spray this onto the weeds, if there are any. Do this in the soil preparation stage and before planting. The mixture should not touch the leaves of the plants as it is too concentrated for the leaves.

9. ***Leave the soil for 14 days before planting the crop so that the micro-organisms can multiply before you plant the crop.*** Water the soil every 7 days while it is under preparation. The water gives life to the micro-organisms.

4. Seed Preparation

1. Put the seeds in a cloth or sock and soak them for a full 24 hours before planting in water that contains 20 cc of Bio-Plant and 20 cc of Pro-Plant per 20 litres. If the amount of seeds is small, which is the case here, reduce the water to just a few litres, but do not reduce the amount of the bio-fertilizers. *The amount of Bio-Plant can be increased to 100 cc for a better effect.*
2. For large seeds, in this case maize, mix 100 cc of Bio-Plant with 1 kg of the seeds (no water), then sow the seeds. This latter approach is very effective. But we often hear from farmers that it is beneficial to soak large seeds, such as maize seeds, for 24 hours as well as dip them in Bio-Plant when they plant them, and they recommend doing this.
3. In the case of rice, farmers often leave the seeds to soak as above, and then leave them in the heat of a sack after soaking them in the mixture for up to 2 days until they start to germinate before sowing them.
4. Throw onto the soil on Day 1 the water mixed with the bio-fertilizer that was used to soak the seeds.
5. **Sowing Rice Seeds:** When the farmers sow the seeds, they flood the field with water and then sow the seeds. Then they let the water flow out at once. This stops the birds eating the seeds.

5. Spraying Pro-Plant

Notes:

- Shake the bottle vigorously before opening it. Pour it into a suitably-sized container and mix it with water according to the amounts below. Turn on the water tap so that the water pours into the container ***very rapidly***.
- 5 cc = one full tea spoon. 30 cc = 2 tablespoons.

Rice and Maize

- Land Area 15 m x 15 m: Spray 50 cc of Pro-Plant mixed with 50 litres of water every 10 days from Day 30 onwards – on Day 30, 40, 50, 60, 70, and 80.
- Land Area 30 m x 15 m: Spray 100 cc of Pro-Plant mixed with 100 litres of water every 10 days from Day 30 onwards – on Day 30, 40, 50, 60, 70, and 80.
- In the case of the 110- or 125-day kind, spray also on Day 90 and Day 100.
- Make sure that you do not spray Pro-Plant downwind into the Control Area of the field as this will affect the comparison with the test area.
- Please spray Pro-Plant using spraying equipment that gives a fine, misty spray, and that the spray is directed diagonally upwards so that it hits the pores of the leaves underneath as well as lands on the leaves. Spray the leaves well and ideally before 9 AM when the leaf pores are open most.
- Continue spraying until 7-10 days before the rice is harvested.

6. Notes

- **Pesticides:** Please do not to spray any chemical sprays during the test because they kill the micro-organisms.. Make sure that any chemical sprays used in other test areas do not blow downwind into the bio-fertilizer test areas.
- **Rice - Actual Practice in Vietnam:** When the farmers release water into the fields every 2 weeks they mix 500 cc of Bio-Plant with each 500 litres of water, which is enough for 1 hectare. In other

words, they add additional Bio-Plant during the crop, which is a good idea. I do not know if you will flood such a small area of rice though. If you do, add 50 cc with the water that you flood the rice area with.

7. Bio-chemical Farming Field Test Guidelines

- **Bio-chemical Farming Test Area C**: Bio-Plant mixed with urea and NPK + Pro-Plant sprayed on the leaves.
- **Bio-chemical Farming Test Area D**: Bio-Plant mixed with urea and NPK + Pro-Plant sprayed on the leaves.
- **Bio-chemical Farming Test Area E:** Bio-Plant mixed with urea and NPK only.

Preparing and Applying the Bio-chemical Fertilizer

- In the bio-chemical farming test halve the amount of chemical fertilizer that you normally use by mixing Bio-Plant with each bag of chemical fertilizer.
- The normal ratio is to mix 330 cc of Bio-Plant with each 50 kgs bag of Urea or NPK.
- You can mix in some water, but not so much that the chemical fertilizer takes a long time to dry out.
- I do not know how much Urea and NPK the local farmers use on 15 m x 15 m., but the ratio is 330 cc of Bio-Plant per 50 kgs bag of chemical fertilizer.
- Prepare the mixture about an hour before using it. Place a 50 kgs/bag of the chemical fertilizer on a plastic sheet (1.5 m x 1.5 m) on the ground. Spread out the fertilizer and spray the bio-fertilizers on top. Then mix the two together well before using them. Make sure that every granule touches the Bio-Plant. Use it the same day.
- If the farmer wants to use it another day, they should let it dry in the wind, but this is not the recommended method.
- Make sure that the farmer shakes the contents of the bottles by turning them upside down and shaking them. If the contents go hard, dilute the bio-fertilizer with a little water.
- By mixing 330 cc of Bio-Plant with a 50 kgs bag, the farmers can use this bag over twice the usual area. (So, 1.5 x 50 kgs bags of the bio-chemical mixture can be used over the same area used by 3 x 50 kgs bags of chemical fertilizer.)
- By halving the amount of chemical fertilizer as described here for bio-chemical farming, the yield will increase by about 10% in the first season compared to chemical fertilizers when used on their own. The cost will be much less, though.
- The farmers should apply the bio-chemical mixture in the normal way and on the same days as they would apply urea or NPK.

8. The Control Area (1,800 m in Size)

- Rice and maize should be planted on the same size of areas of land as in the bio-fertilizer test. If you wish, Test Area E could be left out as it is the same as Test Area D.
- Use urea and NPK on these areas in the normal way that farmers use them.
- The soil should not be prepared with the bio-fertilizers and / or organic matter as chemical farmers do not usually use either to prepare the soil.

Control Tests	
Test Area A (Rice) 15 m x 15 m	**Test Area C (Rice)** 30 m x 15 m
Test Area B (Maize) 15 m x 15 m	**Test Area D (Maize)** 30 m x 15 m
	Test Area E (Maize) 30 m x 15 m

Annex 2: Submission of Bio-Fertilizer Test Results From the Four District Sites

SIERRA LEONE GOVERNMENT
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OFFICE OF DIRECTOR OF EXTENSION

***FROM**: Director of Extension MAFFS*
***TO:** Hon. Minister MAFFS*
***THRO:** Chief Agriculture Officer, MAFFS*
***Cc:** Mr. David Suale, Consultant Coordinator, Head of Fertilizer unit MAFFS.*

DATE: 03/12/15

SUBMISSION OF BIO-FERTILIZER TEST RESULTS FROM THE FOUR DISTRICT SITES

Please find attached the above report for your attention and action

This report has a summary of the following

1. *The original draft project proposal for funding*
2. *The four district Site reports with an attempt to show the pictorial performance of the Bio-fertilizer when applied versus the non-applied areas*
3. *Challenges and Recommendations for future programme intervention on scaling up field activities since the programme has been very successful irrespective of the constraints encountered in its implementation in the absence of funds.*
4. *Some literature on the Techniques used in the field programme implementation as a follow up.*

Anticipating for your usual comments and advice.

B.J. Bangura

Director of Extension MAFFS

Annex 3: Bio-fertilizer Proposal 2015

PROJECT TITLE: **INVESTIGATING THE USE OF THE ORGANIC ERTILIZER (BIO - FERTILIZER) UNDER…….. FOR RECOMMENDATION TO MAFFS BEFORE INTRODUCTION TO FARMING COMMITTEES IN SIERRA LEONE**

1. Background

The Ministry of Agriculture Forestry and Food Security has had over the years numerous challenges in the use of both organic and inorganic fertilizers with farmers who are the direct beneficiaries.

The concept of the effective use of any category of fertilizer has to be accepted by the farmers for any effective demand and use with the main objective of increasing yields of planted crops and hence bring more money into the farmer's pockets.

The use of organic fertilizer in the past was more limited to solid manure like man-made compost, plants and animal wastes. However because of advanced technologies, organic fertilizer also called Bio-fertilizer are now in the form of liquid in well concentrated form to reduce the bulkiness. This means where organic manure may require so many metric tones to be applied in a given area one may only need one or two litres of Bio-fertilizer put into a travelling bag - very convenient to travel with. Even though both organic and inorganic fertilizers are very expensive but the reduced bulkiness bio-fertilizer has got over inorganic fertilizer has raised a lot of interest with farmers. Nevertheless, its effectiveness in showing quick result on crop planted unlike inorganic fertilizer is also a concern and a serious challenge with farmers who are eager to have a quick turnover and bring money into their pockets. However, the long term restoration of the soil, getting higher prices for bio-fertilizer plant products in the world market among other benefits have waken up the idea of using bio-fertilizer in modern farming.

Even though the interest of using bio-fertilizer is there but the question still remains answered which one is better for farmers to own and perhaps gradually replace it with their inorganic traditional fertilizer. Hence the purpose of this finding.

2. Project Amount: Le 57,448,000 (USD 11,280)

3. Assumptions

3.1 The Bio-fertilizer to be applied in accordance with its instructions stipulated for effective use with strict supervision.-

3.2 The Bio-fertilizer, being a liquid should not be applied in irrigated or flooded water or else it will not be effective due to further dilution.

3.3 The District Extension Officers will work together with the District Crop Officer so that once the Bio-fertilizer has been accepted by farmers its wider promotion will be enhanced in crop production by the Crop Division

4. Objectives:

4.1 Farmers to accept the use of this Bio - fertilizer as an alternative to Inorganic fertilizer based on the advantages it has over the other.

4.2 Farmers to increase crop yields when Bio - fertilizer is applied and bring more project to the farmers in a sustainable manner whether the programme is on going or not.

4.3 Farmers to continue the use of Bio-fertilizer in other crops like assorted vegetables and not only limited to rice and maize.

5. Inputs

Three categories of inputs are required

5.1 Planting materials improved and maize is the case may be

5.2 Simple farm tools digging hoes, cutlass, shovels and head pans are needed for the wet bed nursery preparation and land preparation

5.3 Bio-fertilizer. At least one litre per location for one cropping season of rice and maize

5.4 Labour in the form of man/days is required.

6. Methodology

6.1 Well selected Site for rice and maize should be done at close proximately in order to use supervision.

6.2 One FBO for rice and one for maize should be selected and work according to the timelines set in the working calendar

6.3 If 100% of the labour is done, the FBO 100% of the harvest will be for the respective FBO. However, if some of the inputs and labour are provided by the programme a certain negotiated percentage will be agreed upon so that 50% recovery will be made to continue programme in other areas.

6.4 District Extension Officers, Crop and M/E Officers should closely work together for proper coordination and expansion of the technology.

6.5 The four (4) locations – Newton (Western Area), Bo Chinese farm (Southern area), Lambayama (Eastern Region) and Makali (Northern Region) will be maintained for rice and maize double cropping of the programme.

6.6 A Controlled plot will be introduced adjacent within the same location totalling one acre (0.4Ha) for rice and one acre (04Ha) including the Controlled. This mean that half acre (0.2 ha) of one acre of rice/maize is the Controlled while other portions of both crops is for the BIO-fertilizer.

6.7 Close monitoring both at District level will be done in all stages of implementation.

7. Working Calendar - Seed Attached For Details

7.1 Main or (rain fed) season for rice and maize in the first cropping season (April to August 2015)

7.2 Off Main season (Irrigated/dry season) for Rice and Maize in the second cropping season (Sept. -Dec 2015) spilling up to January of the following year.

8. Budget Summary:

Description	Rice	Maize	Total (Le)
1. Planting Material	80,000	56,000	136,000
2. Simple Tools	445,000	445,000	890,000
3. Bio-Fertilizer And Labour	270,000	270,000	540,000
4. Labour On Cultivation	1,320,000	1,100,000	2,420,000
5. M/E Activities	600,000	600,000	1,200,000
Sub-Total	**2,715,000**	**2,471,000**	**5,186,000**
HQ & District Supervision	1,000,000	1,000,000	2,000,000
Total For One Location/Season	3,715,000	3,471,000	7,186,000
Total For 4 Locations/Season			28,744,000
Total for 4 locations for two cropping seasons			Le 57,488,000 USD 11,497.6

9. Cost Analysis:

From the proceeds, the results of rice and maize should be able to show the increase in yield in the applied Bio-fertilizer areas compared with the Controlled areas where no Bio- fertilizer was applied.

10. Possible Conclusions:

A conclusion will be arrived if one or more of the following will be applicable:

10.1 The farmers implementing the programme do admire at both the physiological growth with encouraging yields to convince them that indeed using the Bio-fertilizer is very beneficial or not.

10.2 Effective demand will be made by the respective farmers who had been in partnership with the programme implementation. They will also convince others to buy from any service provider selling this fertilizer under a registered or uniformed price on direct sale to farmers.

10.3 District sales outlet are popularized with District Service Providers to ease transportation and price Control.

Submitted by

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Director of Extension